

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings of claims in the application:

Listing of Claims:

1. **(Canceled)**
2. **(Currently Amended)** A machine according to claim 4 13 wherein the line of action achieved by the two X and Z movements of the wheelhead is 45° to the Z-axis.
3. **(Withdrawn)** A method of simultaneously cylindrical and face grinding a workpiece using a conventional grinding wheel wherein a wheelhead on which the grinding wheel is mounted is moved simultaneously parallel to and perpendicular to the axis of rotation of the workpiece so as to define a line of action along which the wheelhead moves towards and into engagement with the workpiece to perform a single plunge grind operation along that line of action, the amount of material removed from the cylindrical and radial faces of the workpiece by engagement with the grinding wheel being just sufficient to form the shoulder and adjoining cylindrical surface in said single operation.
4. **(Withdrawn)** A method according to claim 3 in which the cylindrical surface which is to be ground extends over an axially greater distance than that corresponding to the width of the wheel, the cylindrical surface is ground in a conventional manner (such as by means of a series of adjacent plunge grinds) leaving an annulus of unground material which extends axially over a distance which is less than the width of the wheel from an adjoining radial shoulder which is to be ground to size, whereafter the wheelhead is advanced along a selected line of action so as to remove the unground annulus and grind the adjoining radial face to size in a single plunge grind along the said selected line of action.
5. **(Canceled)**
6. **(Canceled)**

7. **(Withdrawn)** A method of simultaneously grinding cylindrical and radial faces of a workpiece using a conventional grinding wheel, in which the latter is advanced along a line which is perpendicular to the axis of rotation of the workpiece, but which rotates about an axis which remains parallel to the workpiece axis of rotation throughout, and the workpiece is moved axially in a direction parallel to the axis about which the wheel is rotating, so that the movement of the grinding wheel relative to the workpiece is along a line of action which subtends an angle of less than 90° to the axis of rotation of the workpiece, so that the external cylindrical surface of the grinding wheel will remove material from the cylindrical surface of the workpiece-to be ground, and an adjoining circular face of the wheel will engage and remove material from the radial face of the workpiece, and the angle made by the line of action relative to the axis of rotation is selected so that just the desired amount of material is removed from the said radial face, as the external cylindrical surface of the wheel removes material from the cylindrical face of the workpiece to bring it to size.

8. **(Canceled)**

9. **(Canceled)**

10. **(Withdrawn)** A method of simultaneously grinding cylindrical and radial surfaces of a workpiece in which a grinding wheel having two perpendicular frusto-conical grinding faces around its periphery is mounted for rotation about an axis which is coaxial with the coincident axes of the two cones of which the frusto-conical grinding surfaces form a part, the grinding wheel is mounted on a wheelhead so that one of the said orthogonal frusto-conical grinding surfaces will cylindrically grind a cylindrical surface of the workpiece, and relative movement is effected between the wheelhead and the workpiece so that the wheel engages the workpiece with the said one of the frusto-conical surfaces engaging to the cylindrical workpiece surface, and the other frusto-conical surface simultaneously engaging the radial surface which is to be ground, and a single plunge grind is performed along the line of action defined by the said relative movement such that just the required amount of material is removed from the two orthogonal surfaces of the workpiece as to leave both ground to size after the single

plunge grind, and coolant fluid is directed into the region of engagement between at least one pair of grinding and workpiece surfaces.

11. (Canceled)

12. (Withdrawn) A method according to claim 10 further comprising the step of dressing at least one if not both of the frusto-conical grinding surfaces, particularly that which engages a radial surface of a workpiece.

13. (New) A grinding machine for grinding a rotating workpiece, the grinding machine having an X-axis and a Z-axis, in which the Z-axis is the axis of rotation of the workpiece and the X-axis is perpendicular thereto, the grinding machine comprising:

a machine wheelhead mounted for movement parallel to the X and Z-axes of the grinding machine;

a grinding wheel mounted on the machine wheelhead and mounted for rotation about an axis which remains parallel to the Z axis;

a cylindrical surface on the grinding wheel that is parallel to the axis of rotation of the grinding wheel and a circular face on the grinding wheel that is perpendicular to the axis of rotation of the grinding wheel;

X and Z-axis drives for moving the wheelhead relative to the workpiece parallel to the X and Z axes respectively; and,

control signals for advancing the wheelhead and the grinding wheel along the X and Z-axes and for causing the wheelhead to advance toward and into engagement with the workpiece along a line of action which subtends an angle of less than 90° to the Z-axis, the line of action being such as to simultaneously plunge grind a radial annular shoulder at an end of the workpiece and to grind a cylindrical surface adjoining the shoulder on the workpiece during a single advance of the grinding wheel towards the workpiece.

14. (New) A computer controlled grinding machine programmed to advance a wheelhead for grinding a rotating workpiece, the grinding machine comprising:

a grinding wheel mounted on the wheelhead, the grinding wheel having an axis of rotation, a cylindrical surface that is parallel to said axis of rotation, and a circular face

that is perpendicular to said axis of rotation, the axis of rotation of the grinding wheel being parallel to the axis of rotation of the workpiece; and,

X and Z axis drives for driving the wheelhead and the grinding wheel along a selected line of action into engagement with the workpiece, the line of action extending at an angle of less than 90° to the axis of rotation of the workpiece, so that unground material forming part of a cylindrical surface of the workpiece can be ground by the cylindrical surface of the grinding wheel and an adjoining radial end face of the workpiece can be ground by the circular face of the grinding wheel in a single plunge grind, in which the wheelhead moves along the said line of action into engagement with the workpiece and away therefrom after grinding.

15. (New) A grinding machine comprising:

a wheelhead which is adapted for movement along a first X-axis;

a grinding wheel mounted on the wheelhead and having an axis of rotation, the grinding wheel having an external cylindrical grinding surface on the periphery of the wheel that is parallel to the axis of rotation and a circular grinding surface on the face of the wheel that is perpendicular to the axis of rotation;

a carriage which is adapted for movement parallel to a Z-axis that is perpendicular to the X axis;

a workpiece that is carried by the carriage, the workpiece being mounted for rotation about the Z-axis;

an X-axis drive for advancing and retracting the wheelhead parallel to the X-axis, the grinding wheel axis of rotation remaining parallel to the Z axis as the wheelhead moves parallel to the X axis;

a Z-axis drive for moving the carriage and the workpiece parallel to the Z-axis; and,

X and Z-axis drive control signals for the X and Z-axis drives to produce simultaneous movement of the wheelhead and workpiece such that the movement of the wheelhead relative to the workpiece is along a line of action which subtends an angle with the Z-axis which is less than 90°, the external cylindrical surface of the grinding

wheel engaging the workpiece to remove material from the cylindrical surface of the workpiece, and an adjoining circular face of the grinding wheel engaging a radial shoulder of the workpiece to grind the radial shoulder to size as the wheelhead is advanced along the said line of action.

16. **(New)** A computer controlled grinding machine comprising:
 - a wheelhead carrying a grinding wheel that advances and retracts along a first axis;
 - a workpiece that is mounted for rotation and is movable by means of a carriage along a second axis that is parallel to the axis of rotation of the workpiece and perpendicular to said first axis; and,
 - the grinding wheel being mounted for rotation about an axis which is parallel to the workpiece axis of rotation, the grinding machine advancing the wheelhead and the workpiece carriage along the first and second axes to produce a net movement of the wheelhead relative to the workpiece along a line of action which subtends an angle of less than 90° relative to the axis of rotation of the workpiece.
17. **(New)** The computer controlled grinding machine of claim 16 in which the line of action subtends an angle of 45° relative to the axis of rotation of the workpiece.